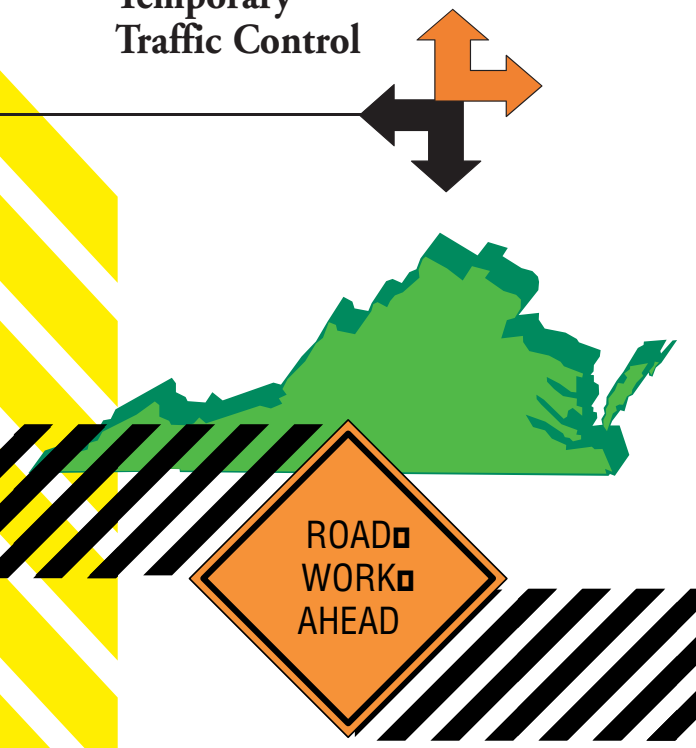
Work Zone Safety

Guidelines *for* Temporary Traffic Control



Virginia Department of Transportation

VDOT

May 2004

Table of Contents

Table of Contents

Introduction

The purpose of this handbook is to present basic guidelines for work zone traffic control and to supplement the *Virginia Work Area Protection Manual.* This handbook presents the requirements of Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) with particular emphasis on short term work sites on roads and streets in rural and urban areas. These requirements apply to temporary traffic control zones, as found in construction, maintenance, and utility work areas.

This handbook presents information and gives examples of typical traffic control applications for two-lane and multilane work zones. This information is intended to illustrate the principles of proper work zone traffic control, but is **not** a standard. The *Virginia Work Area Protection Manual* contains the standards for temporary traffic control zones for roadways in Virginia and can be accessed at VirginiaDOT.org, Business Networks.

Traffic Control Devices

The following are four types of traffic control devices commonly used in work zone traffic control:

- Signs
- Channelizing Devices
- Lighting Devices
- Truck Mounted Attenuators

Signs

Signs used in work zone traffic control are classified as regulatory, guide, or warning. Regulatory signs impose legal restrictions and may not be used without permission. Guide signs commonly show destinations, directions, and distances. Warning signs give notice of conditions that are potentially hazardous to traffic.

Warning Signs

Construction and maintenance warning signs are used extensively in street and highway work zones. These signs are normally diamond shaped, having a black symbol or message on an orange background. As a general rule, these signs are located on the right-hand side of the street or highway. On divided roadways with a median of 8' or greater, both left and right sides should be signed.

Size

The standard size for advance warning signs in work zones is generally 48" by 48". Where Right of Way or geometric conditions preclude use of 48" by 48" signs, 36" by 36" signs may be used.

Mounting

Standards for height and lateral clearance of post mounted roadside signs are included in the *Virginia Work Area Protection Manual.* Signs mounted on temporary supports may be at lower heights but the bottom of the sign shall not be less than one foot above the pavement elevation.

Warning Signs

Sheeting Requirement
Warning signs shall be fluorescent orange prismatic lens sheeting for daytime or nighttime use. Roll-up type material signs, or an approved composite type sign, may be used on portable sign supports for up to three (3) consecutive days (72 hours). Mesh signs are not allowed.

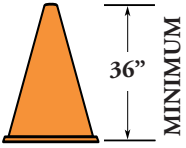
Spacing of Signs
Signs shall be spaced as follows:

Spacing of Advance Warning Signs	
Urban Street with 25 mph or less posted speed.	200' ±
Urban Streets with 30 to 35 mph posted speed limit.	250' ±
Roadways with 45 mph or less posted speed limit.	350' - 500'
Roadways with greater than 45 mph posted speed limit.	500' - 800'
Limited Access Highways	1000' - 1500'

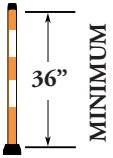
Removal of Signs
To retain the validity and respect of advance warning signs, when operations have ceased or conditions have changed such that the warning signs are no longer warranted, the signs and portable sign supports shall be removed from the roadway.

Channelizing Devices

GROUP 1

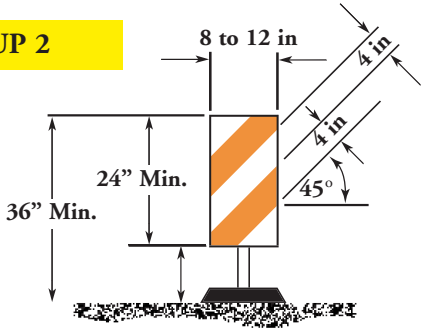


CONES

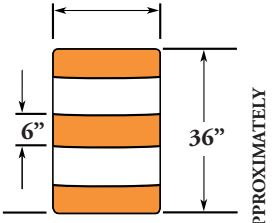


TUBULAR MARKER

GROUP 2



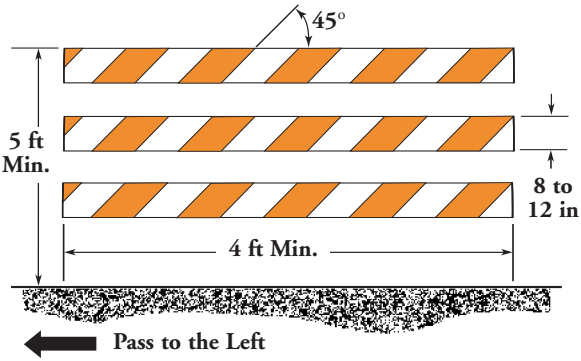
VERTICAL PANEL



DRUM

Notes:

1. Flashing or steady burn warning lights, when used, shall be NCHRP 350 compliant with the type of device it is used on.



TYPE III BARRICADE

Notes:

1. Stripes on barricade rails slope downward at an angle of 45 degrees in the direction traffic is to pass.

2. Type III barricades shall be NCHRP 350 compliant.

3. Ballast shall not be placed on top of any striped rail.

Channelizing Devices (continued)

Channelizing devices are used to warn and alert drivers of hazards in work zones, to protect workers, and safely guide and direct drivers past the hazards. Channelizing devices include cones, tubular markers, drums, vertical panels, temporary raised islands, and barriers. The most common channelizing device used in short term work sites is the traffic cone.

Traffic Cones

Traffic cones shall be orange in color and a minimum of 36 inches in height. Cones used at night shall be retroreflectorized by either a 13 inch white band placed 3 inches from the top, or by a 6 inch band and a 4 inch band spaced 2 inches apart.

Vertical Panels

Vertical panels shall be 8 to 12 inch in width and at least 36 inch in height with 6 inch retroreflectorized orange and white stripes.

Channelizing Devices

Spacing

Channelizing devices should be spaced so that they make it apparent that the roadway or work area is closed to traffic. To accomplish this, the devices should be spaced based on the posted speed and by the following guidelines:

Channelizing Device Spacing

Work Zone Location	Posted Speed Limit	Spacing
In Transitions and Curves	35 mph or less	20'
Parallel to the Travelway	35 mph or less	40'
Spot Construction Access*	35 mph or less	80'
In Transitions and Curves	Greater than 35 mph	40'
Parallel to the Travelway	Greater than 35 mph	80'
Spot Construction Access*	Greater than 35 mph	120'

*** For easier access by construction vehicles into the work area, spacings may be increased to this distance, but shall not exceed one access per quarter mile.**

Drums

Plastic drums must be a minimum of 36 inches in height and at least 18 inches in diameter with alternating orange and white retroreflective stripes 6 inches wide. Each drum shall have a minimum of two orange and white stripes. Spacing of drums shall be the same as for cones. To ensure that the work zone is properly protected, drums shall be used to delineate unmanned work areas.

Lighting Devices

Lighting devices for short term construction, maintenance, and utility work zones are designed to supplement the signs and channelizing devices used in these zones. Typical lighting devices include warning lights, vehicle lights, and flashing arrow panels.

Warning Lights
The principal types and use of warning lights are:

1. **Low Intensity Flashing Lights (Type A)** used to warn of an isolated hazard at night.
2. **High Intensity Flashing Lights (Type B)** normally mounted on advance warning signs to draw attention to a hazard both day and night.
3. **Low Intensity Steady-Burn Lights (Type C)** used in a series to delineate the edge of the travelway and channelize traffic at night.
4. **Low Intensity 360° Steady-Burn Lights (Type C)** used in a series same as type C lights when delineation is required from multiple sides.

Vehicle Lights
Lighting greatly enhances the visibility of work vehicles and increases their recognition factor as a slow moving hazard. Rotating Amber Lights or High Intensity Amber Strobe Lights shall be used on vehicles performing moving and mobile operations, and should be used on vehicles entering and exiting the work zone at night.

Flashing Arrow Panels

Flashing Arrow Panels are used on vehicles in mobile operations, and placed at the beginning of lane closure tapers. Arrow displays shall have the following mode selections:

- flashing arrow
- flashing double arrow
- flashing caution (four corners)

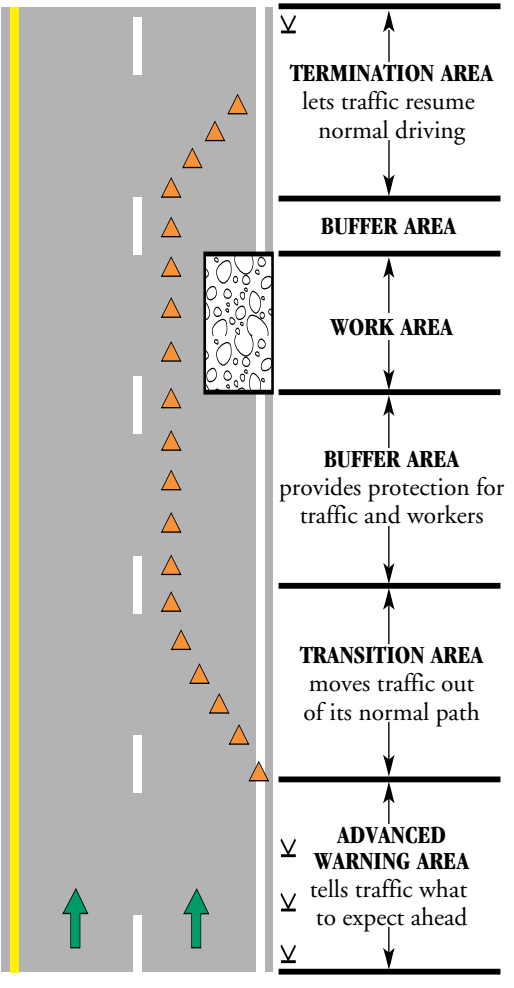
Arrow Panel Size Requirements

Type	Min. Size	Min. No. Lamps	Min. Legibility Distance
A	48" x 24"	12	1/2 mile
B	60" x 30"	13	3/4 mile
C	96" x 48"	15	1 mile

Notes:

1. Arrow panels in the typical application diagrams shall be a **Type B** or **C** unless otherwise noted.

Component Parts of a Temporary Traffic Control Zone



Five Parts of a Temporary Traffic Control Zone

The temporary traffic control zone is the distance between the first advance warning sign and the point beyond the work area where the traffic is no longer affected. Above is a diagram showing the five parts of a temporary traffic control zone.

Buffer Area

The length of a longitudinal buffer is determined by the posted speed limit and should be as shown in the chart below.

Buffer Space Length Chart	
Posted Speed (MPH)	**Distance (Feet)**
20 and below	120
25	160
30	200
35	250
40	310
45	360
50	425
55	500
60	570
65	650

Taper Length Criteria for Work Zones

There are five types of tapers used in work zone traffic control. The length of each type of taper is based on the speed of traffic and the width of the offset (or lane width). The following are the five types of tapers and their lengths.

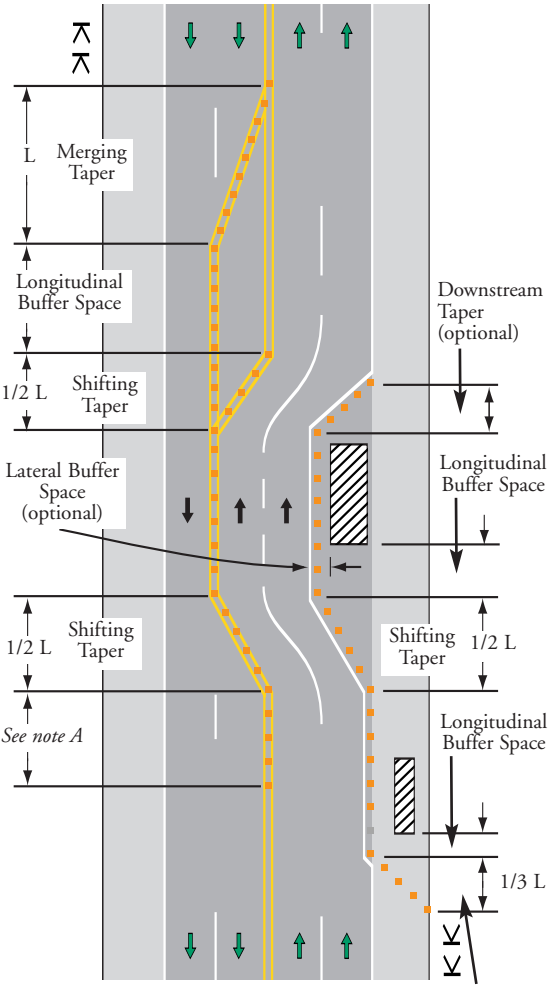
Type of Taper	Taper Length
Merging	L Minimum
Shifting	L Desired, 1/2 L Min.
Shoulder	1/3 L Minimum
Two-way	100 Feet Maximum
Downstream	100 Feet per Lane

Taper Length (L) Chart:

Taper Length (L)					
Speed (S) in MPH	Width of Offset (W) in Ft.				Remarks
	9	10	11	12	
25 or below	**94**	**105**	**115**	**125**	**$L=S^2W/60$**
30	135	150	165	180	"
35	**184**	**205**	**225**	**245**	**"**
40	240	270	294	320	"
45	**405**	**450**	**495**	**540**	**L=SW**
50	450	500	550	600	"
55	**495**	**550**	**605**	**660**	**"**
60	540	600	660	720	"
65	**585**	**650**	**715**	**780**	**"**

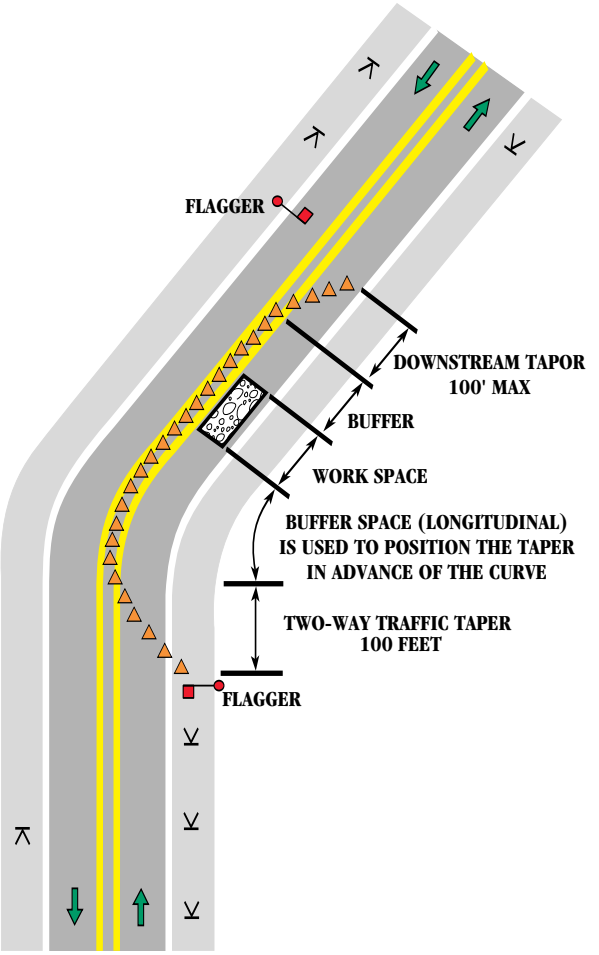
Minimum Taper Length for Limited Access Highways Shall Be 1000 Feet.

Types of Tapers and Buffer Spaces



Note A:
Four times the posted speed limit in feet

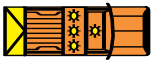
Work Zone Applications in Curves and Hills



Work Zone Applications in Curves and Hills

When the work activity occurs in a curve or the down side of a hill, consideration should be given to the placement of the advance warning devices. It is always best to place the warning signs, arrow panel, and taper devices in a tangent or straight section of roadway for maximum visibility. This may involve extending the lane closure and increasing the buffer area to accomplish. The figure above shows an application of this concept. If the lane closure cannot be lengthened due to roadway constrains, then the length of the taper should be increased to provide additional merge area for vehicles. On hills, the signs, taper and arrow panel should be seen prior to reaching the crest of the hill.

Truck Mounted Attenuators



A truck mounted attenuator (TMA) vehicle is required in all lane and/or partial ramp closures on four or more lane roadways when the posted speed limit is 45 mph or greater, and for mobile operations which fully or partially block a lane on roadways posted 45 mph or greater. TMA units used on limited access highways and on four or more lane Primary roadways posted 55 mph or greater shall be NCHRP 350, Test Level 3 units. All other roadways may use NCHRP 230 or NCHRP 350, TL 2 units until July 1, 2005.

Placement of the TMA vehicle shall be 50'-100' in front of the first work crew, equipment, or hazards that traveling motorists would encounter. Each TMA vehicle shall have at least one rotating amber light or high intensity amber strobe light functioning while in operation.

Installing/Removing Lane Closures

Care must be exercised when installing and removing lane closures. All stationary lane closures begin and end as mobile operations. The traffic control needed to perform the operation safely is dictated by the location on the roadway the mobile operation will occur; either on the shoulder or partially or fully in the lane.

Installing Lane Closures

Stationary lane closures should be installed with the flow of traffic in the following sequence:

1. Install all advance warning signs.
2. Place arrow panel on the shoulder at the beginning of the merging taper.
3. Place channelizing devices to form a merging taper.
4. Install the buffer space.
5. Continue placing channelizing devices through the work area at the correct spacing.
6. Install an "END ROAD WORK" sign approximately 500' beyond the last device in the lane closure.
7. Place a TMA vehicle, if required, 50'-100' from first work crew or hazard approached by motorists.

A "ride through" through the entire lane closure should be performed (with adjustments made to the traffic control devices if needed) to ensure that the lane closure is installed and functioning properly.

Removing Lane Closures

Stationary lane closures should be removed against the flow of traffic in the following sequence:

1. Remove channelizing devices from end of closure back to the widest part of the merging taper.
2. Place removal vehicle on shoulder and remove devices from taper by hand onto backing vehicle.
3. Remove arrow panel after ensuring roadway is clear.
4. Moving with the flow of traffic, remove all of the advance warning signs beginning with the "ROAD WORK AHEAD" sign and ending with the "END ROAD WORK" sign.

Use of a TMA vehicle when installing and removing lane closures on multi-lane roadways increases the safety of the operation for both the worker and the traveling public, and should be used whenever the shoulder width prevents these operations from being performed completely off of the travelway.

Definitions

The following are several important definitions for terms used in these guidelines. These definitions were developed to aid the supervisor at the job site in determining the appropriate traffic control for the existing street or highway conditions. If the traffic conditions or work status changes during the course of the work, then the traffic control must change also.

Low Speed
As a general rule, a low speed road can be considered one on which the posted speed is less than 45 miles per hour (MPH).

Low Volume
As a general rule, a low volume road can be considered one which the average daily traffic (ADT) volume does not exceed 500 vehicles per day. If the traffic volumes are not known, the following rule of thumb can be used to determine if the road can be treated as low volume for the purposes of installing work zone traffic control:

Count the number of vehicles that pass a single reference point over a five minute period. If not more than 3 vehicles pass the reference point in that period, then the road can be considered low volume.

Definitions (continued)

The following are categories of work duration and their time at a location:

Mobile Operation
Work that moves intermittently or continuously (0-15 minutes) and does not occupy the immediate area for more than 15 minutes. The immediate area is defined as a 1000'± linear foot distance.

Short Duration
Occupies a location from 15 minutes to 1 hour.

Short-term Stationary
Occupies a location for more than 1 hour but less than 12 hours.

Intermediate-term stationary
Occupies a location more than one daylight period up to 3 days, or nighttime work lasting more than 1 hour.

Long Term Stationary
Occupies a location longer than 3 days.

Typical Application Diagrams

The diagrams on the following pages represent examples of the application of principles and procedures for safe and efficient traffic control in temporary traffic control zones and are not intended to be standards. It is not possible to include illustrations to cover every situation which will require work area protection. These typical layouts are not intended as a substitute for engineering judgement and should be altered to fit the conditions of a particular site.

The information presented in these diagrams are minimums for standard highway (non-limited access) conditions with posted speeds of 55 mph or less. For urban conditions (a low speed, two-lane street located inside a municipality's corporate limit) shorter spacings and lengths may be required. Expressways and freeway conditions will require longer distances. For further information, refer to the *Virginia Work Area Protection Manual*; the standard for temporary traffic control in the Commonwealth of Virginia.

Legend


Channelizing Device


Flagger


Portable Sign Support


Warning Sign


Flashing Arrow Panel

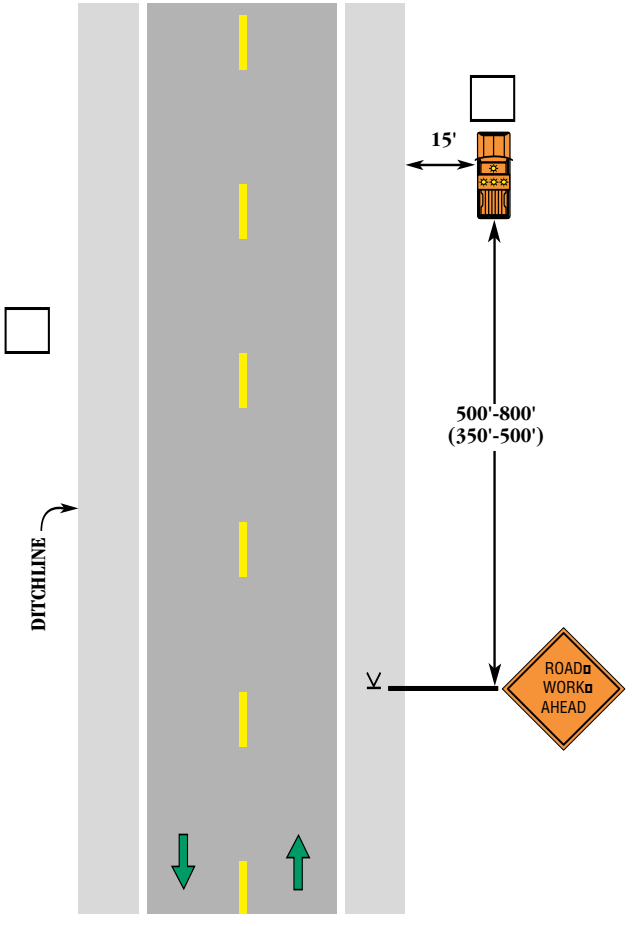

Work Area


Flashing Light


TMA Vehicle

Work Outside the Shoulder

(15' or More From the Edge of Pavement)



Work Outside the Shoulder

Notes:

1. If vehicle and work activity are both outside the right-of-way, behind the ditchline, behind the guardrail, more than 2' behind the curb, or 15' or more from the edge of any non-limited access roadway, then only an activated rotating amber light or high intensity amber strobe light is needed.

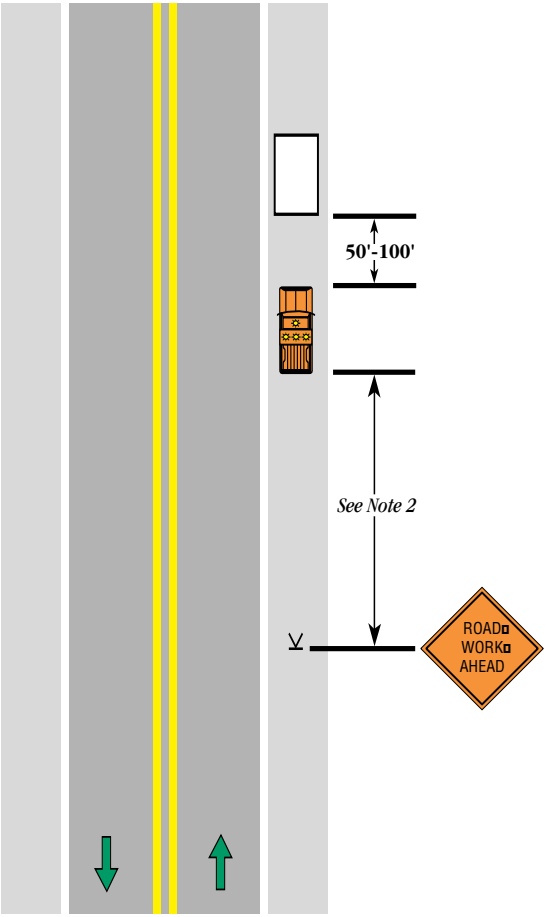
2. An advance warning sign should be used: if the work will be performed immediately adjacent to the shoulder, if equipment will cross or move along the roadway, or if the activity may distract motorists.

3. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

4. Other acceptable advance warning signs are those indicating shoulder work or utility work ahead.

Shoulder Work - Mobile Operation

(15 Minutes or Less in the Immediate Area)



Shoulder Work - Mobile Operation

Notes:

1. Where multiple work locations occur in a 5 mile area, stationary signing should be installed, unless the distance between the work locations is 1 mile or more, and if the work vehicle travels at traffic speeds between locations.

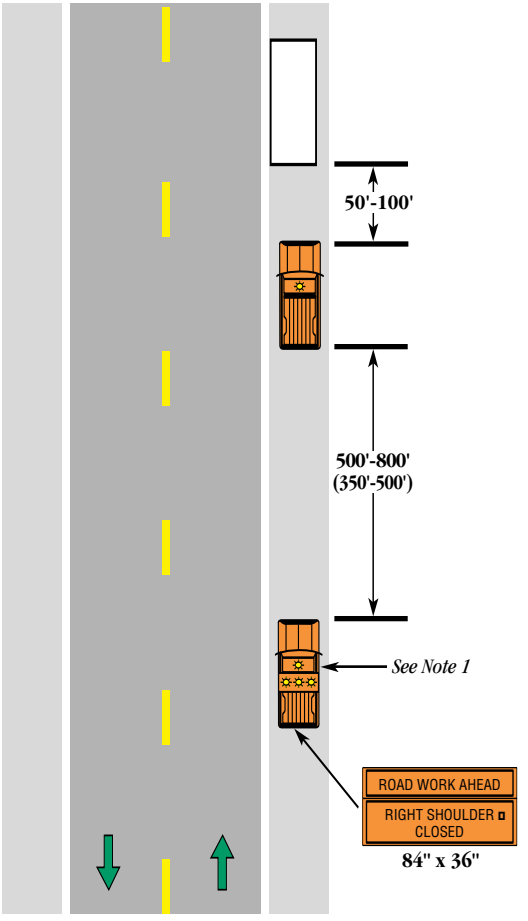
2. The minimum distance between sign and work vehicle should be 350'-500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph. The maximum distance between sign and work vehicle is 5 miles.

3. Each vehicle involved in the mobile operation shall have at least one rotating amber light or high intensity amber strobe light.

4. "Utility Work Ahead", or "Shoulder Work Ahead" signs may be used.

Shoulder Work - Short Duration Operation

(16 Minutes to 60 Minutes in the Immediate Area)



Shoulder Work - Short Duration Operation

Notes:

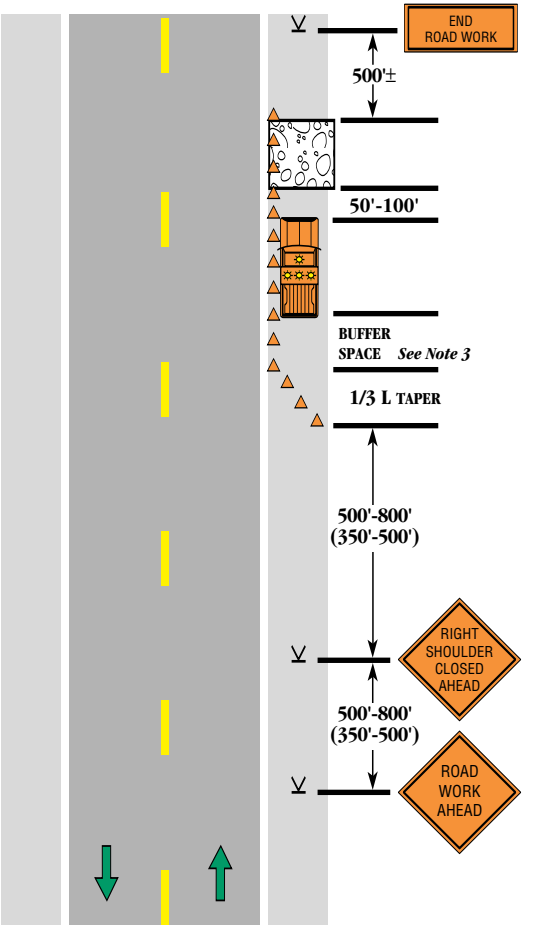
1. The first advance warning vehicle may be replaced by a 48" x 48" "Road Work Ahead" sign.

2. Each vehicle involved in the short duration operation shall have at least one rotating amber light or high intensity amber strobe light.

3. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

Shoulder Work - Stationary Operation

(Greater Than 60 Minutes in the Immediate Area)



Shoulder Work - Stationary Operation

Notes:

1. On divided roadways having a median wider than 8', left and right sign assemblies shall be required.

2. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

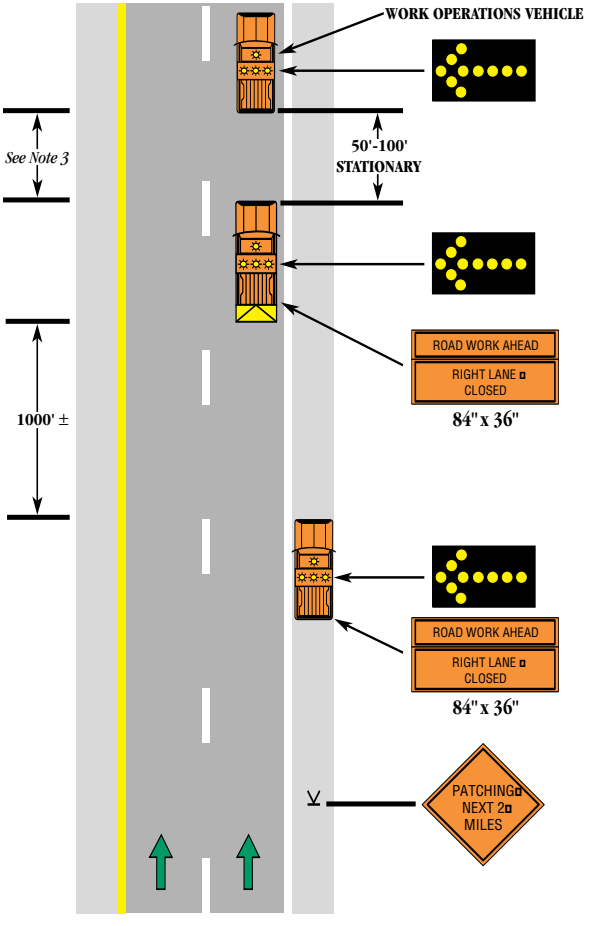
3. For length of the buffer space, see Buffer Space Length Chart on page 14.

4. A vehicle with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.

4. A "Utility Work Ahead" sign may be used in place of the "Road Work Ahead".

Four-lane Road - Mobile Operation

(15 Minutes or Less in the Immediate Area)



Four-lane Road - Mobile Operation

Notes:

1. Each vehicle involved in the mobile operation shall be equipped with at least one rotating amber light or high intensity amber strobe light. All vehicles shown shall have an arrow panel operating in the flashing arrow mode.

2. Arrow direction and lane designation may change as needed.

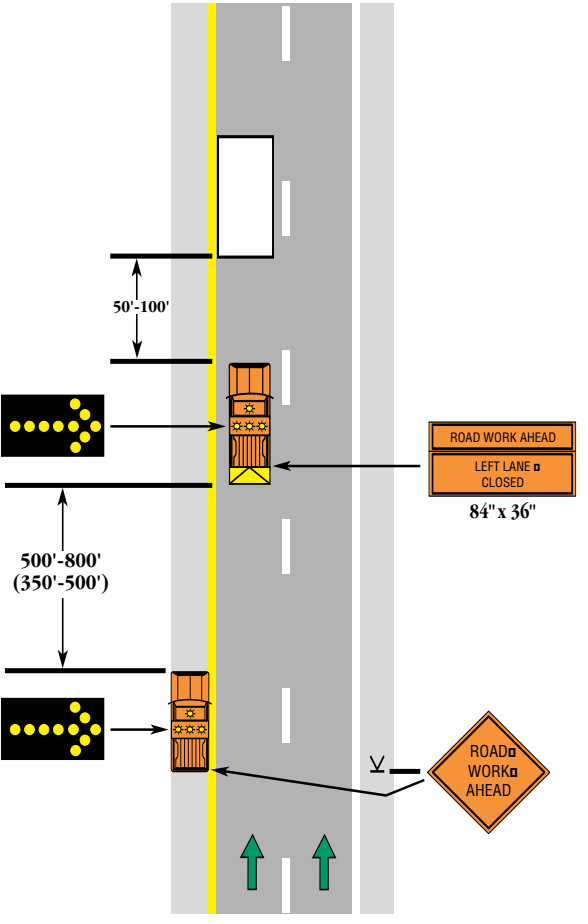
3. When the work operations vehicle is stationary, the second advance warning vehicle shall be in a position 50'-100' in advance of the operations vehicle. When the work operations vehicle is moving, the second advance warning vehicle shall follow at a distance of 300' ± .

4. The static warning sign and arrow panel may be replaced with a vehicle mounted changeable message sign (CMS) with a minimum of 10" height characters.

5. On limited access highways, a third shadow vehicle (not shown) shall be used with shadow vehicle 1 in the closed lane, shadow vehicle 2 straddling the edge line, and shadow vehicle 3 on the shoulder.

Four-lane Road - Short Duration Operation

(16 Minutes to 60 Minutes in the Immediate Area)



Four-lane Road - Short Duration Operation

Notes:

1. Each vehicle involved in the mobile operation shall be equipped with at least one rotating amber light or high intensity amber strobe light. All vehicles shown shall have an arrow panel operating in the flashing arrow mode.

2. Minimum distance between sign/warning vehicle and the TMA vehicle should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

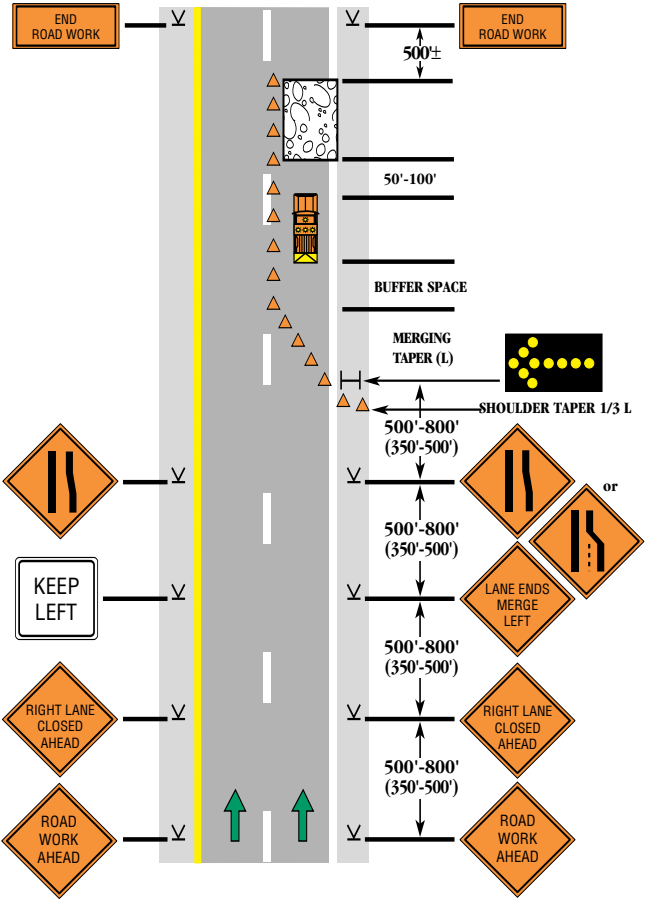
3. The first warning vehicle on the shoulder may be replaced with a "Road Work Ahead" sign on low speed, low volume roadways. If the first vehicle occupies any part of the travel lane, it shall have a TMA or be replaced with the "Road Work Ahead" sign.

4. A TMA shall be used on the advance warning vehicle in the travelway.

5. The static warning sign and arrow panel may be replaced with a vehicle mounted changeable message sign (CMS) with a minimum of 10" height characters.

Four-lane Road - Stationary Right Lane Closure

(Greater Than 60 Minutes in the Immediate Area)



Four-lane Road - Stationary Right Lane Closure

Notes:

1. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

2. For the length of the shoulder taper (1/3 L) and merging taper (L), see Taper Length Chart on page 15.

3. For length of the buffer space, see Buffer Space Length Chart on page 14.

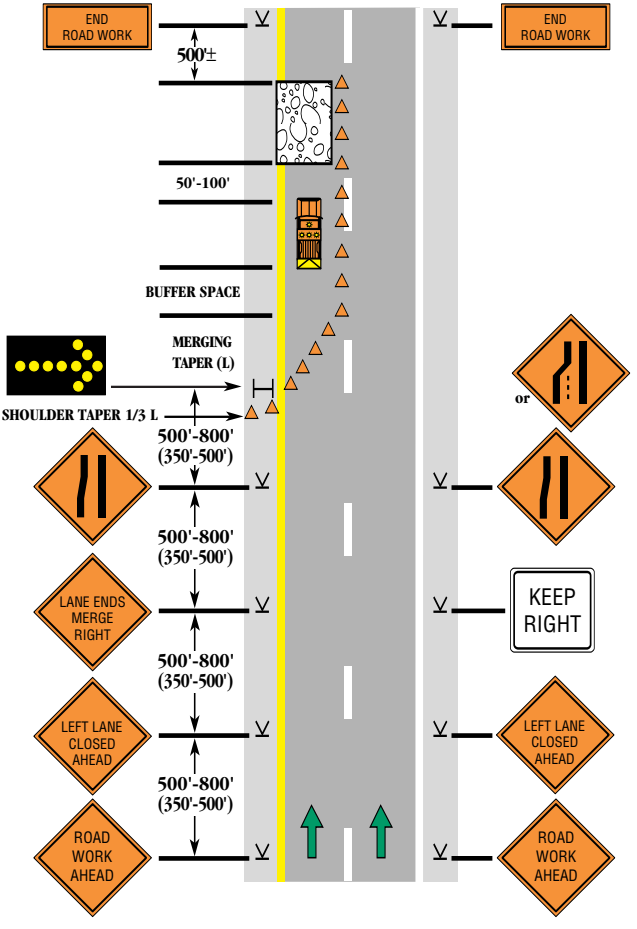
4. A truck with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew. When posted speed limit is 45 mph or greater, a TMA shall be used.

5. The flashing arrow panel shall be a **Type C** only.

Cone Spacing		
Location	**0-35 mph**	**36 + mph**
Transition	**20'**	**40'**
Travelway	**40'**	**80'**

Four-lane Road - Stationary Left Lane Closure

(Greater Than 60 Minutes in the Immediate Area)



Four-lane Road - Stationary Left Lane Closure

Notes:

1. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

2. For the length of the shoulder taper (1/3 L) and merging taper (L), see Taper Length Chart on page 15.

3. For length of the buffer space, see Buffer Space Length Chart on page 14.

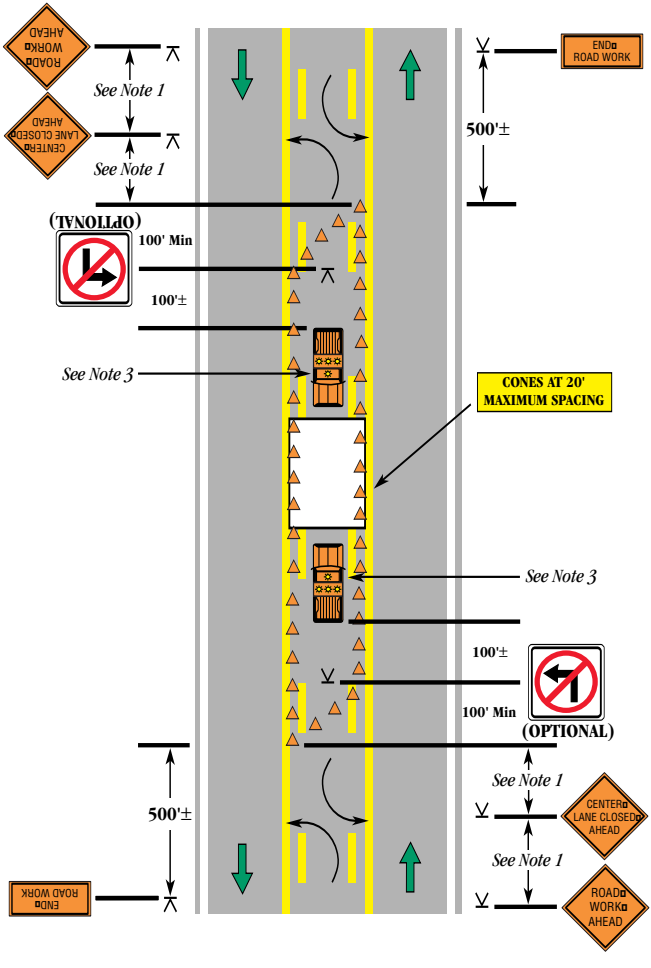
4. A truck with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew. When posted speed limit is 45 mph or greater, a TMA shall be used.

5. The flashing arrow panel shall be a **Type C** only.

Cone Spacing		
Location	**0-35 mph**	**36 + mph**
Transition	**20'**	**40'**
Travelway	**40'**	**80'**

Center Turn Lane Closure on a Three-lane, Two-way Road

(Greater Than 60 Minutes in the Immediate Area)



Center Turn Lane Closure on a Three-lane, Two-way Road

Notes:

1. Distance between signs and beginning of cone taper should be a minimum of 500’ and a maximum of 800’. (For low-speed urban streets, a 200’ ± sign spacing may be used).

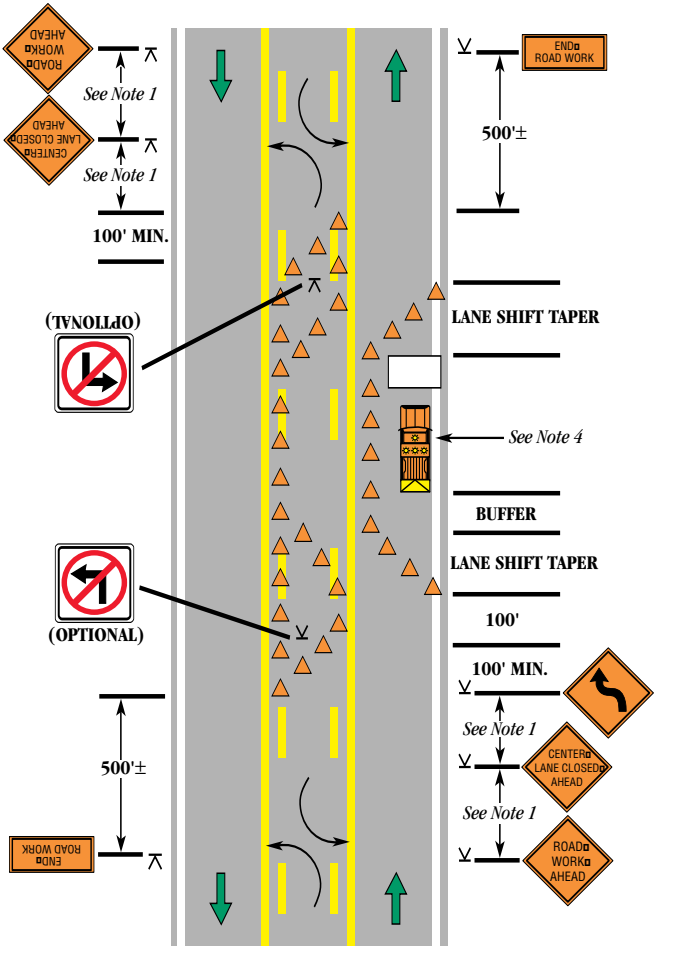
2. To prevent vehicles from turning into the work zone, cone spacing shall be a maximum of 20’ on centers.

3. A protective vehicle with flashing lights shall be parked 50’-100’ in advance of the work crew and shall have a TMA if the posted speed limit is 45 mph or greater.

4. For locations with heavy left turning movements, a graphic “No Left Turn” sign may be used within the closed lane.

Lane Shift on a Three-lane, Two-way Road

(Greater Than 60 Minutes in the Immediate Area)



Lane Shift on a Three-lane, Two-way Road

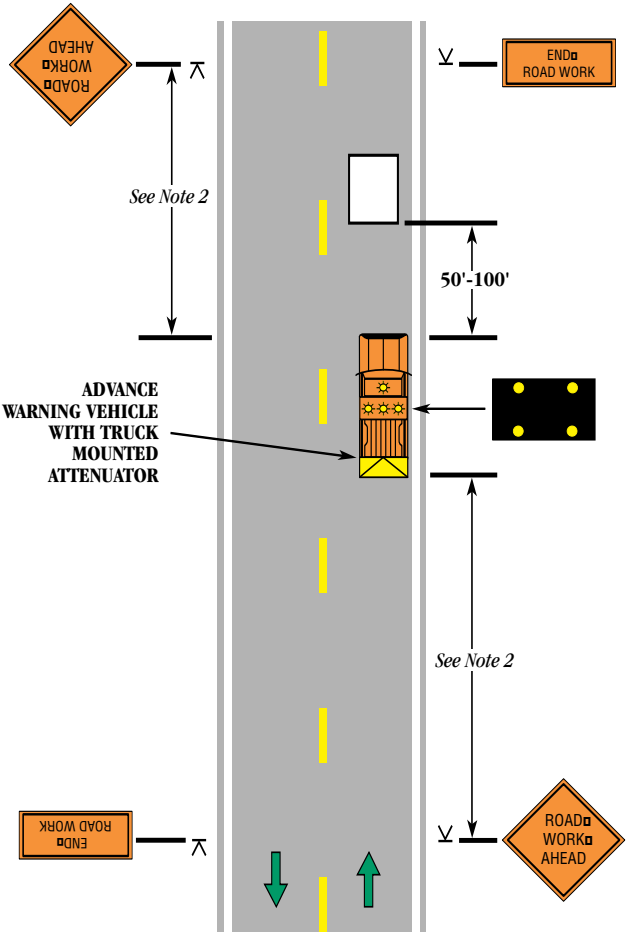
Notes:

1. Distance between signs and beginning of cone taper should be a minimum of 500’ and a maximum of 800’.(For low-speed urban streets, a 200’ ± sign spacing may be used).
2. For the length of the lane shift taper, see Taper Length Chart on page 15.
3. For length of the buffer space, see Buffer Space Length Chart on page 14.
4. A protective vehicle with flashing lights shall be parked 50’-100’ in advance of the work crew and shall have a TMA if the posted speed limit is 45 mph or greater.
5. For locations with heavy left turning movements, a graphic “No Left Turn” sign may be used within the closed lane.

Cone Spacing		
Location	**0-35 mph**	**36 + mph**
Transition	**20’**	**40’**
Travelway	**40’**	**80’**

Two-lane Road - Mobile Operation

(15 Minutes or Less in the Immediate Area)



Two-lane Road - Mobile Operation

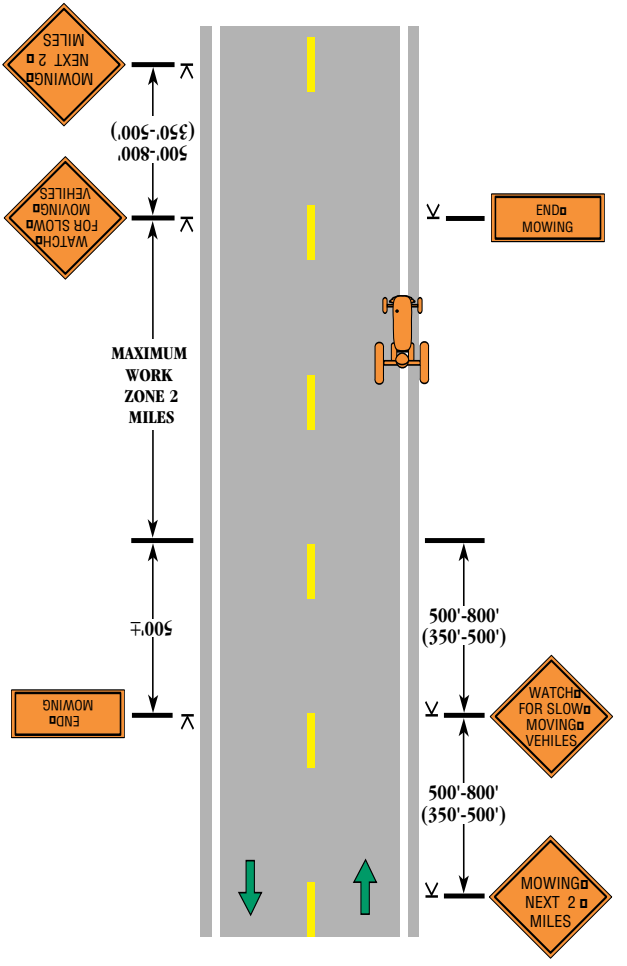
Notes:

1. Each vehicle involved in the mobile operation shall be equipped with at least one rotating amber light or high intensity amber strobe light. **Flashing arrow panels shall not be used in this operation**. Four corner caution mode may be used.

2. The minimum distance between the sign and advance warning vehicle should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph. The maximum distance between the sign and the advance warning vehicle is 2 miles.

3. A TMA should be used on the advance warning vehicle, located 50'-100' in advance of the operation, other vehicles, or equipment.

Two-lane Road - Mowing With Encroachment



Two-lane Road - Mowing With Encroachment

Notes:

1. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

2. The maximum length of the work zone shall be two miles. Only one lane may be obstructed at a time.

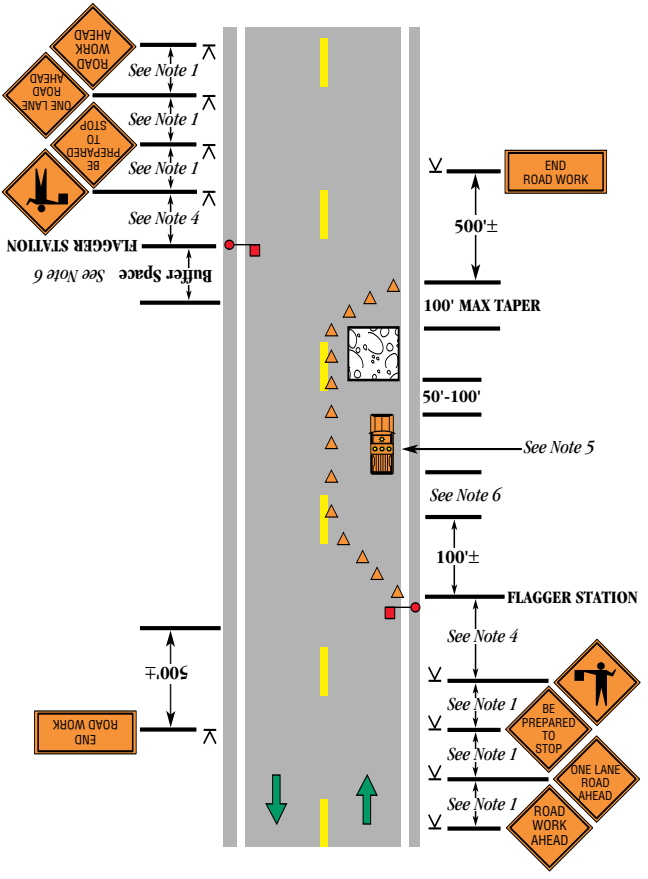
3. Each vehicle involved in the operation shall be equipped with at least one rotating amber light or high intensity amber strobe light.

4. Additional traffic control devices may be required as directed by the District Traffic Engineer.

5. If the operation is completely off the travelway, the "WATCH FOR SLOW MOVING VEHICLES" sign may be omitted.

Two-lane Road - Stationary Closure

(Two Flagger Operation)



Two-lane Road - Stationary Closure

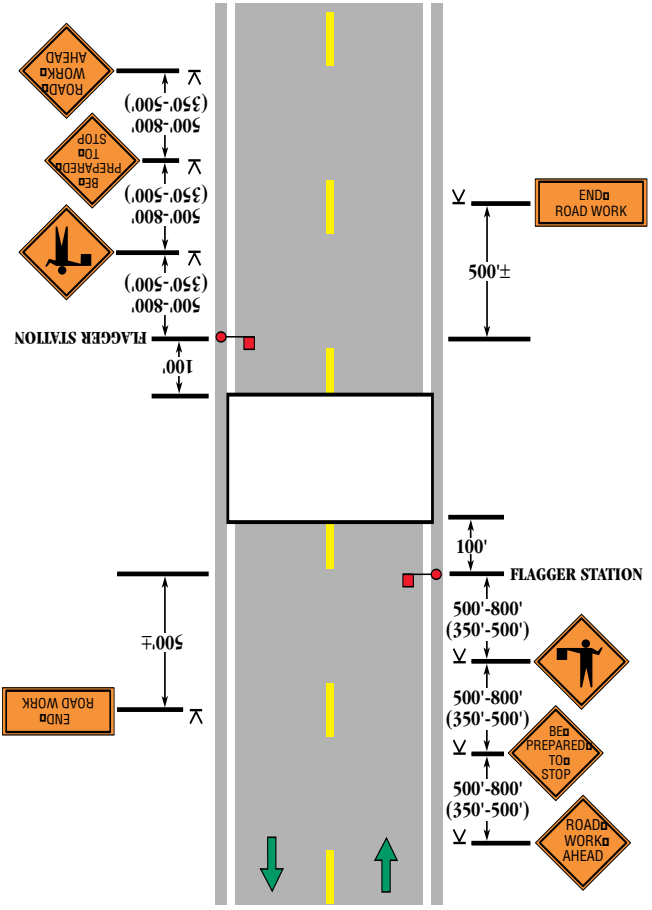
Notes:

1. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.
2. The cone transition length shall be 100' maximum in length.
3. **All flaggers must be state certified and have their certification card in their possession when flagging.**
4. Flagging stations should be located with a desired clear site distance of 500' in advance of the flagger.
5. A truck with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.
6. For length of the buffer space, see Buffer Space Length Chart on page 14.

Cone Spacing		
Location	**0-35 mph**	**36 + mph**
Transition	**20'**	**40'**
Travelway	**40'**	**80'**

Two-lane Roadway - Temporary Disruption

(Not to exceed 15 minutes)



Two-lane Roadway - Temporary Disruption

Notes:

1. Conditions represented are for work which requires closure during daytime hours only, during non-peak travel times.

2. This application is intended for a planned temporary closure not to exceed 20 minutes.

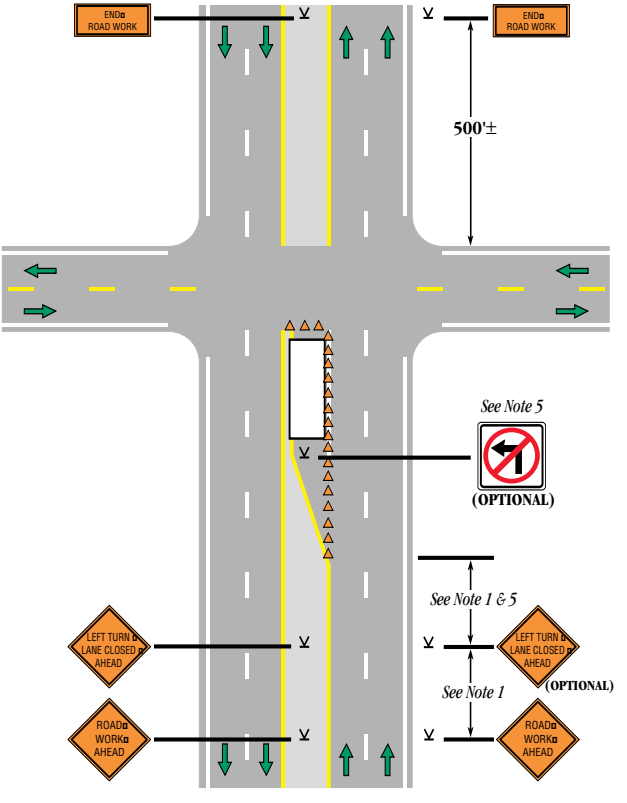
3. **All flaggers must be state certified and have their certification card in their possession when flagging.**

4. For high volume roads, use of police for traffic stoppage is recommended.

5. Additional traffic control devices may be required as directed by the District Traffic Engineer.

Turn Lane Stationary Closure

(Greater than 60 minutes)



Turn Lane
Stationary Closure

Notes:

1. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

2. On divided roadways having a median wider than 8', left and right sign assemblies shall be required.

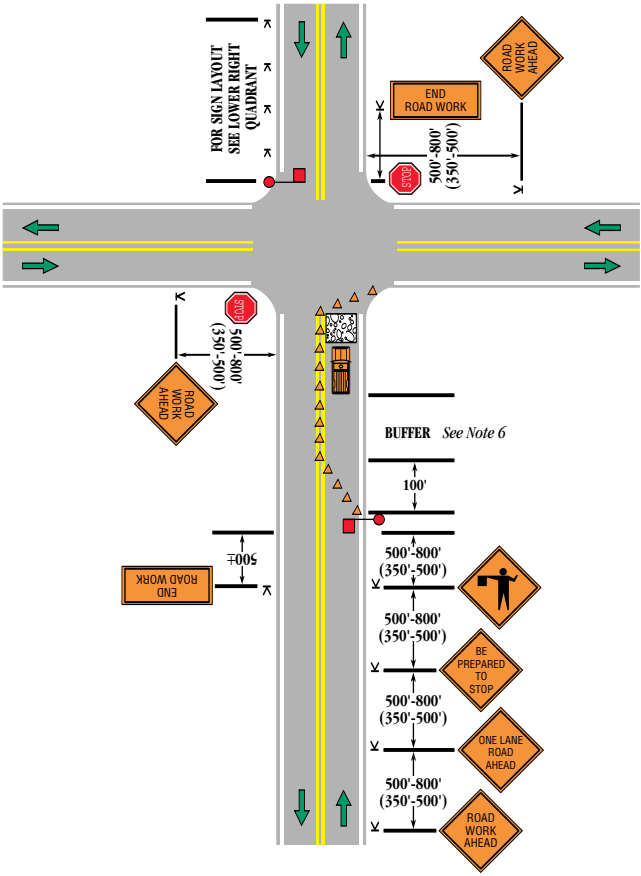
3. To prevent accidental intrusion into the work area, cone spacing shall not exceed 20' on centers.

4. This layout may be used for either left or right turn lane closures.

5. For high turning volumes, additional signing may be required, as directed by the District Traffic Engineer.

Lane Closure in Advance of Intersection (North/South)

(Stop Signs on East/West Approaches)



Lane Closure in Advance of Intersection (North/South)

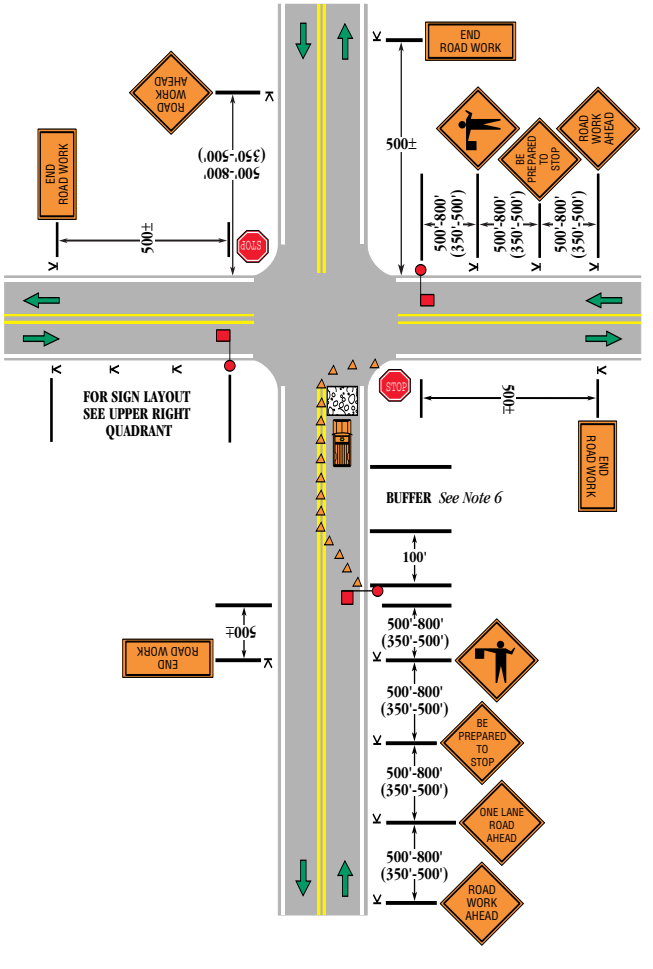
Notes:

1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed on the cross road approaches.
2. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.
3. **All flaggers must be state certified and have their certification card in their possession when flagging**.
4. Flagging stations should be located with a desired clear site distance of 500' in advance of the flagger.
5. A truck with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.
6. For length of the buffer space, see Buffer Space Length Chart on page 14.

Cone Spacing		
Location	**0-35 mph**	**36 + mph**
Transition	**20'**	**40'**
Travelway	**40'**	**80'**

Lane Closure in Advance of Intersection (North/South)

(Stop Signs on North/South Approaches)



Lane Closure in Advance of Intersection (North/South)

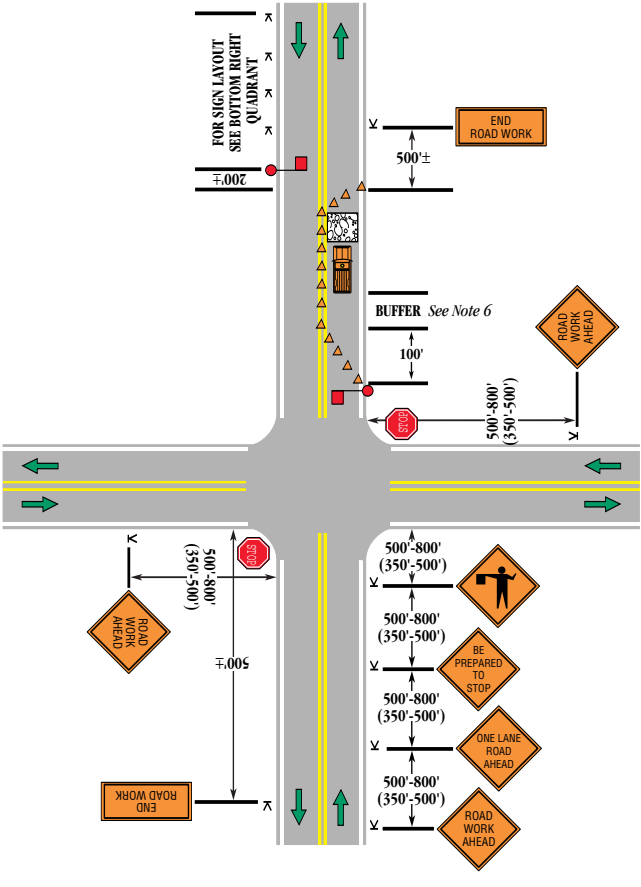
Notes:

1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed on the cross road approaches.
2. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.
3. **All flaggers must be state certified and have their certification card in their possession when flagging.**
4. Flagging stations should be located with a desired clear site distance of 500' in advance of the flagger.
5. A truck with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.
6. For length of the buffer space, see Buffer Space Length Chart on page 14.

Cone Spacing		
Location	**0-35 mph**	**36 + mph**
Transition	**20'**	**40'**
Travelway	**40'**	**80'**

Lane Closure Beyond Intersection (North/South)

(Stop Signs on East/West Approaches)



Lane Closure
Beyond Intersection (North/South)

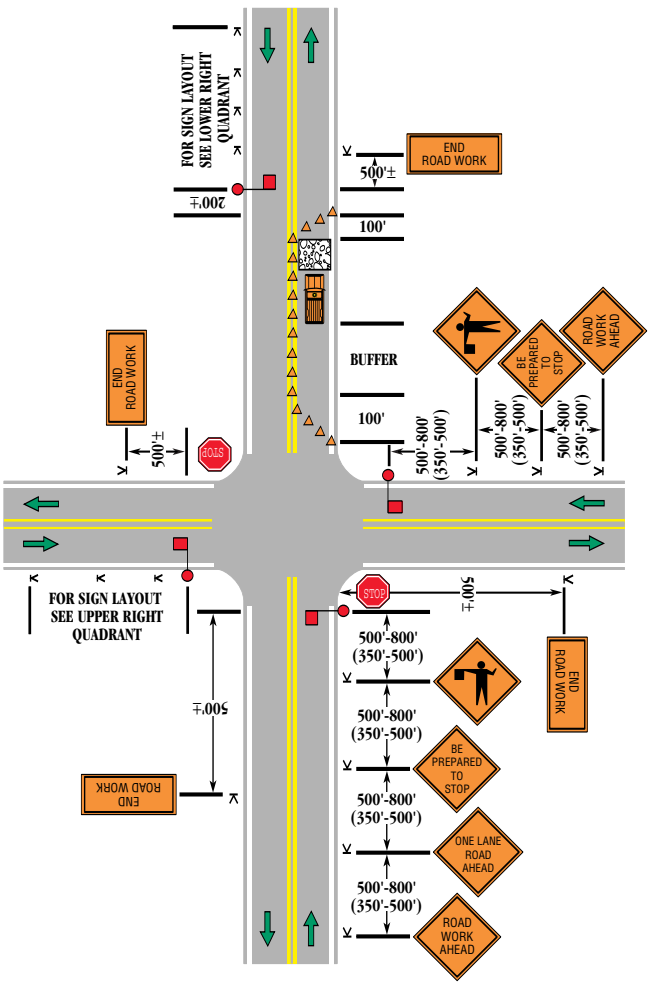
Notes:

1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed on the cross road approaches.
2. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.
3. **All flaggers must be state certified and have their certification card in their possession when flagging.**
4. Flagging stations should be located with a desired clear site distance of 500' in advance of the flagger.
5. A truck with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.
6. For length of the buffer space, see Buffer Space Length Chart on page 14.

Cone Spacing		
Location	**0-35 mph**	**36 + mph**
Transition	**20'**	**40'**
Travelway	**40'**	**80'**

Lane Closure
Beyond Intersection (North/South)

(Stop Signs on North/South Approaches)



Lane Closure
Beyond Intersection (North/South)

Notes:

1. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

2. **All flaggers must be state certified and have their certification card in their possession when flagging.**

3. Flagging stations should be located with a desired clear site distance of 500' in advance of the flagger.

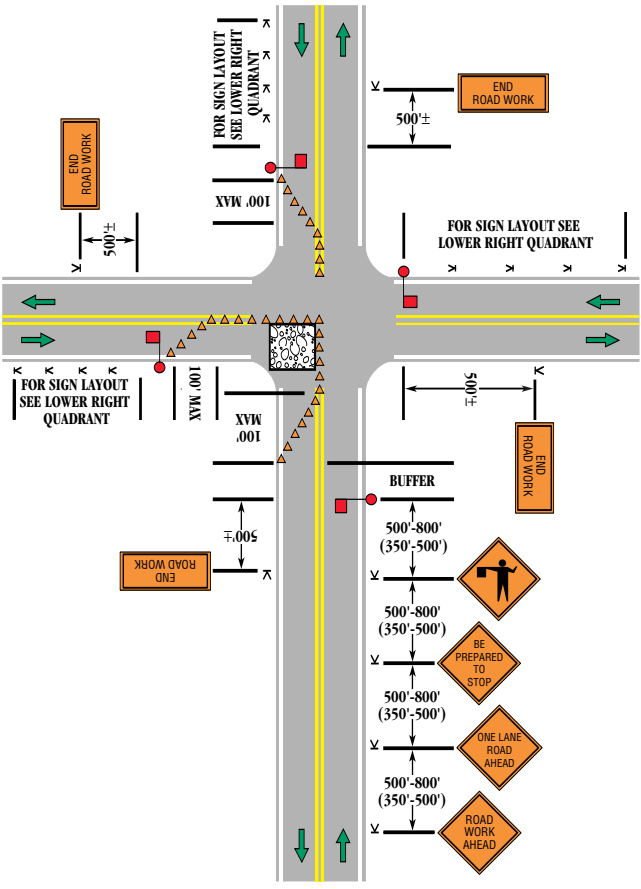
4. A truck with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.

5. For length of the buffer space, see Buffer Space Length Chart on page 14.

Cone Spacing		
Location	**0-35 mph**	**36 + mph**
Transition	**20'**	**40'**
Travelway	**40'**	**80'**

Closure in Center of Intersection

(Greater than 30 minutes in Duration)



Closure in Center of Intersection

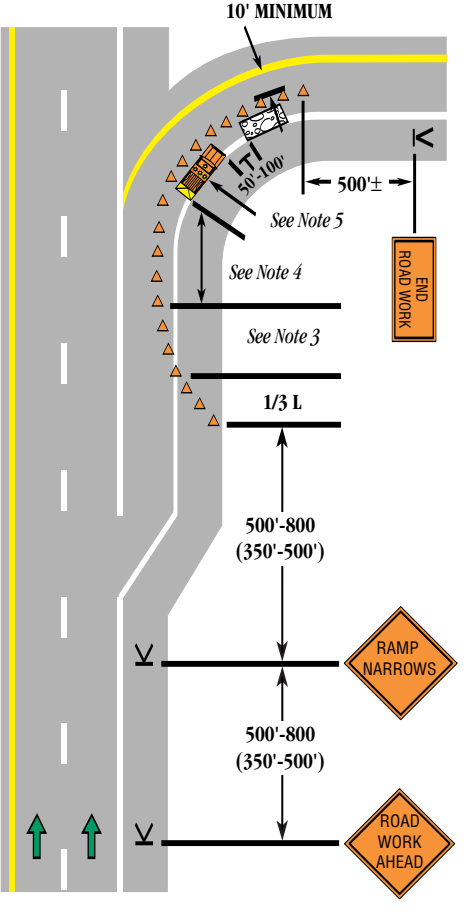
Notes:

1. The control of traffic through the intersection in order of preference:
   A. Obtain the services of law enforcement personnel.
   B. Divert the effective routes to other roads as approved and directed by the VDOT District Traffic Engineer.
   C. Use state certified flaggers on each leg of the intersection as shown.
2. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.
3. Cone spacing shall be on 20' spacing or less.
4. For emergency situations of 30 minutes or less duration, two rotating amber lights or high intensity strobe lights mounted on the vehicle and visible for 360° will be required in addition to channelizing devices around the vehicle.
5. For length of the buffer space, see Buffer Space Length Chart on page 14.

Cone Spacing		
Location	**0-35 mph**	**36 + mph**
Transition	**20'**	**40'**
Travelway	**40'**	**80'**

Partial Ramp Closure Operation

(Greater Than 60 Minutes in Duration)



Partial Ramp Closure Operation

Notes:

1. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

2. To prevent accidental intrusion into the work area, cone spacing shall not exceed 20' on centers.

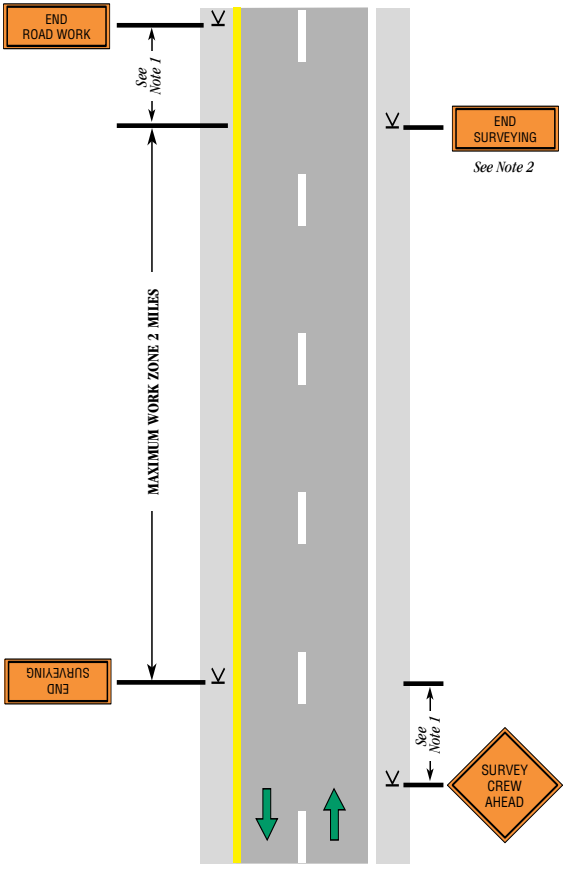
3. Cone Taper Length (L) = actual speed of motorists (S) x width of actual ramp closure (W). [L = S x W] (Example: 270' = 45 x 6)

4. For length of the buffer space, see Buffer Space Length Chart on page 14.

5. A truck with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew. When posted speed limit is 45 mph or greater, a TMA shall be used.

6. Truck off-tracking should be considered when determining whether the 10 foot minimum lane width is adequate.

Surveying Operations



Surveying Operations

Notes:

1. Sign spacing distance should be 350'-500' where the posted speed is 45 mph or less, and 500'-800' where the posted speed is greater than 45 mph.

2. For operations less than 60 minutes, the "End Surveying"sign may be omitted.

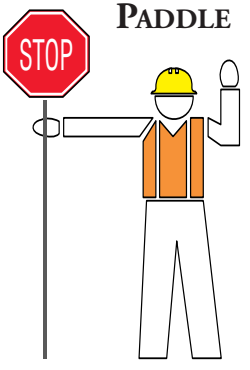
3. Each vehicle involved in the surveying operations shall have at least one rotating amber light or high intensity amber strobe light.

4. Maximum length of the work zone is two miles.

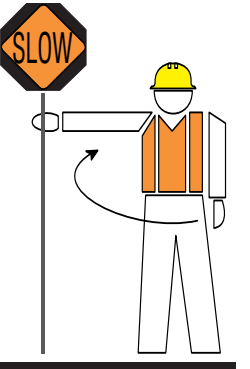
5. Surveying operations shall be off the travelway. For encroachment into the travelway, see flagging or lane closure traffic control.

Flagging Procedures

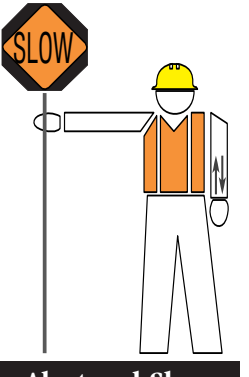
PADDLE



Stop Traffic



Traffic Proceed



Alert and Slow Traffic

Notes:

1. To maintain alertness, flaggers should be relieved every two hours for a minimum period of fifteen minutes.

Flagging Procedures

Flagger Qualifications

- Good physical condition, including sight, mobility and hearing
- Courteous but firm manner
- Skill in communicating specific instructions clearly, firmly and courteously *
- At least 18 years old

(See 6E.01 of the VA WAPM for additional qualifications)

* NOTE: Flaggers shall speak only English while performing their job duty as a flagger.

Properly Trained Flaggers

- State certified with certification card on person
- Properly using hand signals with the STOP/SLOW paddle
- Demonstrating clear messages to motorists as shown above
- Coordinated with other flaggers
- Alert and attentive

Properly Equipped Flaggers

- Approved STOP/SLOW paddles:
  - 24" octagonal sign
  - SLOW side fluorescent orange prismatic lens sheeting
  - STOP side red encapsulated lens sheeting
  - Legible and clean
- Five foot minimum height from bottom of sign paddle to roadway
- Approved safety vest, shirt, or jacket:
  - Orange, yellow, or yellow-green
  - Retroreflective meeting ANSI/ISEA 107-1999 guidelines

Flagging Procedures continued

- Wearing steel toed safety shoes and hardhats meeting OSHA standards

Proper Flagging Stations

- Good approach sight distance (500' minimum)
- Highly visible to traffic
- Positioned away from the work space according to chart below
- Beginning operation from the roadway shoulder
- Never standing in the moving traffic lane
- Standing and flagging alone
- Illuminated at night by a light source

Proper Advance Warning Signs

- Always use correct warning signs, in proper order
- Allow reaction distance from signs to work area
- Always remove flagging signs when not at the flagging station

Flagger Station Distance in Advance of the Work Space

The distance of the buffer space from the end of the taper to the beginning of the work activity should be as shown in the table below.

Posted Speed (MPH)	Distance (Feet)
20 and below	120
25	160
30	200
35	250
40	310
45	360
50	425
55	500
60	570
65	650

Liability

Steps to Minimize Liability

- Have an approved traffic control plan
- Train all personnel in proper work zone safety techniques
- Follow the latest edition of the Virginia Work Area Protection Manual and revisions
- Minimize traffic disruptions
- Inspect work zone sites daily for conformance
- Promptly repair or replace damaged devices
- Promptly remove unneeded devices
- Properly install and remove temporary traffic control devices from the road way
- View the work zone from the road user's perspective (cars, trucks, motorcycles, bicyclists, and pedestrians)
- Keep comprehensive documentation
    - o Written checklist form
    - o Daily diary
    - o Photographs
    - o Video recordings

Daily Checklist

Daily Top Ten Checklist For Temporary Traffic Control		
1	✓	All devices meet specifications and quality standards.
2	✓	All signs properly installed and legible; covered or removed when not needed
3	✓	Arrow displays and PCMS's properly aligned and maintained.
4	✓	Proper taper and buffer lengths established.
5	✓	Channelizing devices are clean, aligned, and properly spaced.
6	✓	Flaggers certified, properly equipped, in the correct location and using hand signals.
7	✓	Temporary barriers and attenuators properly installed and maintained in serviceable condition.
8	✓	Inapplicable traffic control devices removed when not required.
9	✓	Pavement markings in place at end of the work shift.
10	✓	Day and night drive-through inspections conducted and logged or recorded.

Name_____

Notes

VIRGINIA

Give 'em a BRAKE

HIGHWAY WORKERS

Acknowledgements

These guidelines were developed in part by the North Carolina League of Municipalities and the North Carolina Governor's Highway Safety Program. These guidelines have been modified by the Virginia Department of Transportation to meet VDOT's requirements for safety in temporary traffic control zones.

For additional copies of these work zone safety guidelines or the latest edition of the Virginia Work Area Protection Manual or additional information on work zone safety in general, please contact:

Virginia Department of Transportation
Mobility Management Division -
Work Zone Safety Section
1401 East Broad Street
Richmond, VA 23219
1-800-367-ROAD

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